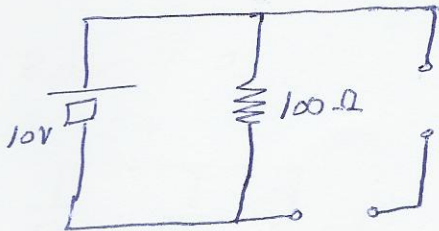


Q1. In the following circuit, find the steady state energy stored in each element (R, L, C):

At the steady state:



$$V_{100\Omega} = 10 \text{ V}$$

$$I_{100\Omega} = \frac{V}{R} = \frac{10}{100} = 0.1 \text{ A}$$

$$I_{2H} = I_{4H} = I_{100\Omega} = 0.1 \text{ A}$$

$$\therefore \mathcal{E}_{2H} = \frac{1}{2} L i^2 = \frac{1}{2} (2) (0.1)^2 = 0.01 \text{ J}$$

$$\mathcal{E}_{4H} = \frac{1}{2} (4) (0.1)^2 = 0.02 \text{ J}$$

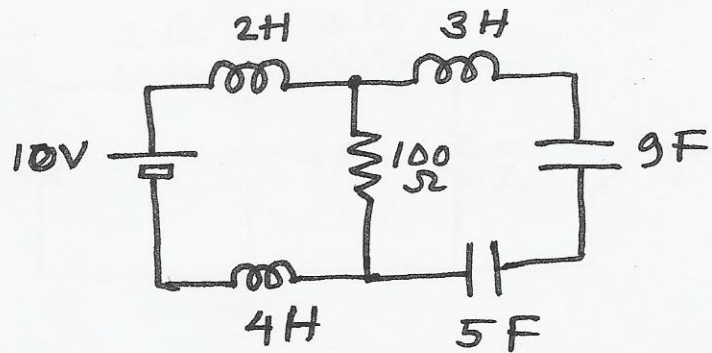
$$I_{3H} = 0 \text{ A}, \therefore \mathcal{E}_{3H} = 0 \text{ J}$$

$$C_{9F+5F} = \frac{9 \times 5}{9+5} = \frac{45}{14} \text{ F}$$

or C_{eq}

$$\therefore V_{C_{eq}} = V_{100\Omega} = 10 \text{ V}$$

$$\therefore \mathcal{E}_{C_{eq}} = \frac{1}{2} \left(\frac{45}{14} \right) (10)^2 = \frac{1125}{7} \text{ J}$$



$$q = CV \Rightarrow q_{eq} = \frac{45}{14} (10) = \frac{225}{7} \text{ C}$$

$$V = \frac{q}{C}$$

$$V_{9F} = \frac{\frac{225}{7}}{9} = \frac{25}{7} \text{ V}$$

$$\therefore \mathcal{E}_{9F} = \frac{1}{2} (9) \left(\frac{25}{7} \right)^2 = 44.6429 \text{ J}$$

$$\mathcal{E}_{5F} = \frac{1}{2} (5) \left(\frac{225}{7 \times 5} \right)^2 = 103.3163 \text{ J}$$

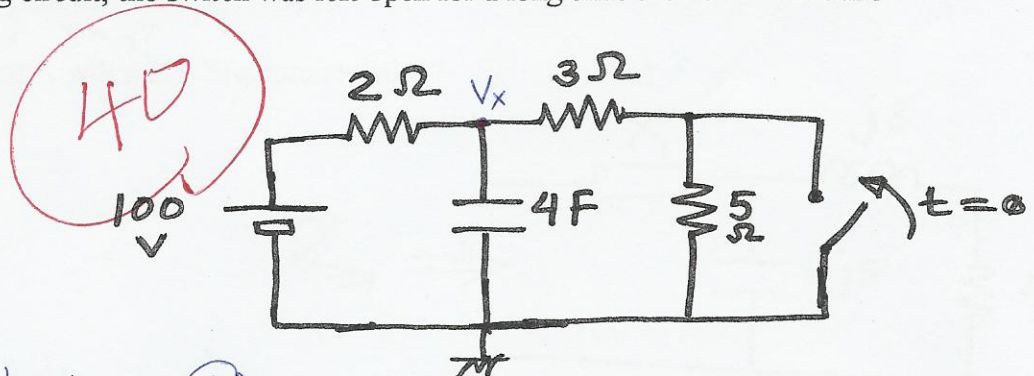
$$\mathcal{E}_{100\Omega} = 0 \text{ J}$$



Q2. In the following circuit, the switch was left open for a long time then closed at time $t = 0$.

Find v_x

1. At $t = 0$
2. At $t = \infty$
3. At $t = 3s$



Steady state:

④

$$V_c = V_{\infty} + (V_0 - V_{\infty})e^{-t/RC}$$

$$V_c = 60 + (80 - 60)e^{-t/4.8}$$

$$V_c = 60 + 20e^{-t/4.8}$$

at $t = 0$

$$V_c = 60 + 20e^{-\frac{0}{4.8}}$$

$$V_c = 60 + 20e^0$$

$$V_c = 60 + 20 = 80 \text{ volt}$$

at $t = \infty$

$$V_c = 60 + 20e^{-\frac{\infty}{4.8}}$$

$$V_c = 60 + 0$$

$$V_c = 60 \text{ volt}$$

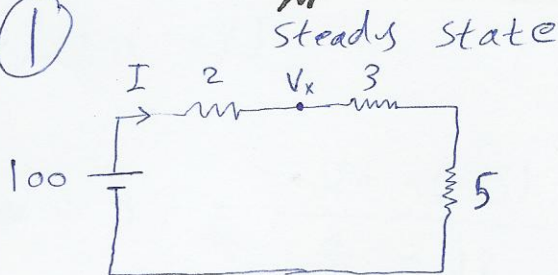
at $t = 3$

$$V_c = 60 + 20e^{-3/4.8}$$

$$= 60 + (20)(0.54)$$

$$= 70.8 \text{ volt}$$

①

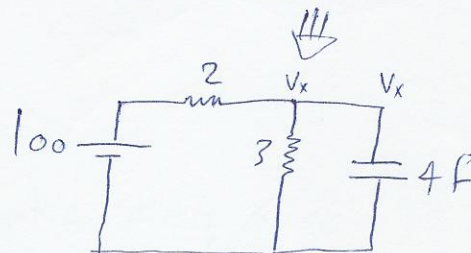
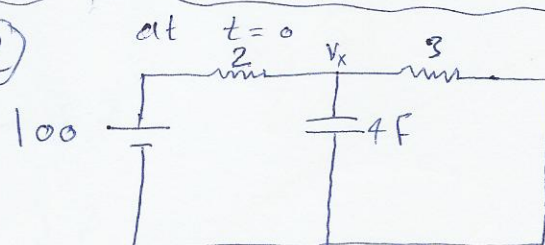


$$I = \frac{V}{R} = \frac{100}{2+3+5} = \frac{100}{10} = 10 \text{ A}$$

$$V_0 = V_x = 100 - 2(I) = 100 - 2(10)$$

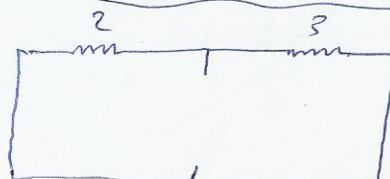
$$V_0 = V_x = 100 - 20 = 80 \text{ volt}$$

②



$$V_x = \frac{100 \times 3}{3+2} = \frac{300}{5} = 60 \text{ volt} = V_{\infty}$$

③

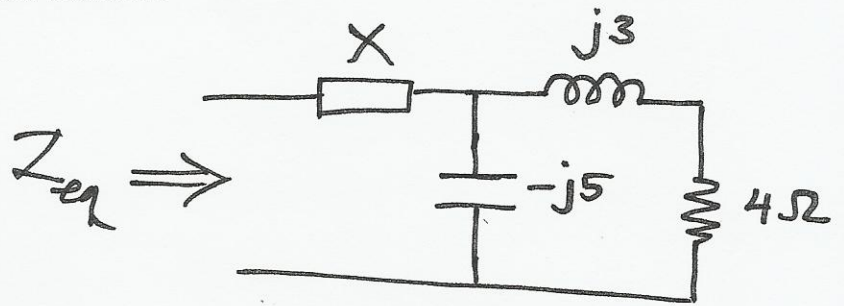


$$R = 2 \parallel 3 = \frac{2 \times 3}{2+3} = \frac{6}{5} = 1.2 \Omega$$

$$RC = (1.2)(4) = 4.8 \text{ sec}$$

Q3. In the following circuit:

1. Find Z_{eq} if $X = -j7$
2. What value of X will make Z_{eq} pure resistive?



$$[1] \quad j3 + 4\Omega \Rightarrow 4 + j3$$

$$[2] \quad -j5 \parallel 4 + j3$$

$$\Rightarrow \frac{1}{Z_{eq}} = \frac{1}{-j5} + \frac{1}{4 + j3}$$

$$\frac{1}{Z_{eq}} = \frac{4}{25} + \frac{2}{25}j$$

$$Z_{eq} = 5 - j2.5$$

$$Z_{eq} = 5 - j2.5 + (-j7)$$

$$= 5 - j9.5$$

40

$$5 - 2.5j$$

Z_{eq} will be pure resistive when $X =$

$$5 = 5 - j2.5 + X$$

$$X = j2.5$$